00001 Multi-Layer Film-Structure, especially Multi-Layer Film
00002 Label-Structure
00003
00004 The invention is concerned with a multi-layer film
00005 structure, especially label-structure for labeling of
00006 bottles, glass bottles as well as plastic bottles, cans,
00007 jars and other containers. Such structures are already
00008 known in a high number of various combinations. A refere-
00009 nce is made for example to EP-B1-84360, EP-B1-450331,
00010 GB-PS-1383622, GB-PS-1284766, US-PS-4 207 402, US-PS-4
00011 904 324, DE-OS-43 15 006, EP-A1-612 613, US-PS-3,275,720
00012 and Belgium patent 706 673.
00013
00014 The film structure, especially printed with for example
00015 trade names, user directions or other information, may
00016 be used for applications such as wrapping of articles,
00017 printed sheets, for example for lying under dishes on
00018 the table. The multi-layer film label-structure will be
00019 used for labeling of bottles, jars and so on.
00020
00021 All the known label-structures have certain advantages
00022 and disadvantages related to the demands especially for
00023 labeling purposes. There is the need for a transparent
00024 label as well as for an opaque label. Further, a good
00025 printability is highly desired. Also, the label should
00026 be able to be applied on a shrink or a non-shrink app-
00027 lication. For a seaming of the label edges and its app-
00028 lication to a container as mentioned above, it should be
00029 possible, to use glue or solvent or a heat sealing te-
00030 chnique with possibly the same label stock. With respect
00031 to production demands, it should be possible, to produce
00032 the label in different modifications without the need to
00033 change too much of the production line or even to use
00034 different production lines. Further aspects are a des-
00035 ired ease of recycling and broad application to various

00036 printing processes. The label surface should be possibly
00037 such that for printing no or nearly no pre-treatment is
00038 required.
00039
00040 Based on this, the invention is concerned with the te-
00041 chnical problem to provide for a concept of a multi-
00042 layer film structure, especially a film label-structure,
00043 being able to fulfil most if not all requirements for
00044 todays demands, especially labeling demands, being pro-
00045 ducible with generally the same equipment with transpa-
00046 rent and opaque properties, whereby possibly the overall
00047 costs of the structure are in the lower region.
00048
00049 This technical problem is first solved by the concept of
00050 claim 1, providing the concept of a multi-layer film
00051 label-structure, having a shrinkability, with a first
00052 and a second outer layer and a third inner layer between
00053 the first and second layer, all layers consisting essen-
00054 tially of polystyrene, whereby the overall thickness is
00055 in the range of 0,5 to at least 4 mils (0,012 to 0,102
00056 mm) and the first and second layer do consist of general
00057 purpose styrenic resins whereas the third layer does
00058 consist of a modified tough polystyrene with modifiers
00059 such as butadiene and/or acrylat and with such an amount
00060 on those modifiers, that the third layer may function as
00061 a carrier layer for the first and second layer, in terms
00062 of allowing to produce the label-structure according to
00063 the coextrusion process. The overall thickness may be
00064 especially up to 0,03; or between the latter value and
00065 up to 0,06; or between the latter value and up to 0,09;
00066 or between the latter value and up to 0,10; or between
00067 the latter value and up to 0,11; or between the latter
00068 value and up to 0,12. This includes also the so called
00069 bubble blowing method. The coextrusion technology is
00070 preferred because of the basic cost and ease of opera-

00071 tion and control. In the coextrusion technique the
00072 preferred practice is to employ a coextrusion die which
00073 has an annular circular opening and the composite struct-
00074 ure is initially formed as a tubular shape by what is
00075 referred to in the art as "blown tubular bubble" te-
00076 chnique. This type of coextrusion die is set fourth in
00077 SPE Journal, November 1969, Volume 25, page 4, entitled
00078 "Coextrusion of Blown Film Lamination". In this known
00079 coextrusion technique, the circular opening is fed from
00080 two or more independent extruders and, in the particular
00081 instance the outer layers could be supplied from separa-
00082 te or a common extruder. The middle layer would be form-
00083 ed from a different extruder than used for the other
00084 layers. The tubular member exiting from the die is blown
00085 into a bubble by conventional "bubble" forming techni-
00086 ques including air cooling of the inner and outer surf-
00087 ace of the bubble. The bubble is pulled away from the
00088 die in the vertical direction as the bubble cools stres-
00089 ses are imparted which form shrink properties to the
00090 label in the machine direction. By balancing the machine
00091 direction pull and the bubble blow-up, the desired mac-
00092 hine direction and cross direction properties for shrin-
00093 king can be controlled. Preferably, the shrinkability is
00094 of a four to one ratio or more (f.e. five to one, six to
00095 one, seven to one, eight to one). Also the further known
00096 coextrusion technique may be employed, i.e. the flat die
00097 extrusion process.
00098
00099 In the case of opaque design, pigments and additives to
00100 form a gas at extrusion temperature can be added to form
00101 a cellular (and lower density) opaque structure. The
00102 term "general purpose styrenic resins" refers to styre-
00103 nic resins with little or no rubber modification. Also
00104 it is refered to so called crystal polystyrene or pure
00105 polystyrene or a polystyrene having very low additives

00106 or modifiers respectivly. The term "modified tough po-
00107 lystyrene" refers especially to highly rubber modified
00108 polystyrene, such as known as high impact polystyrene or
00109 medium impact polystyrene. The letter once are especia-
00110 lly of advantage for the opaque version of the struct-
00111 ure. Further, with respect to the modified tough po-
00112 lystyrenes are known so called styrolux and "K-resin".
00113 "K-resin" is a product of Philipps Petroleum Chemical.
00114 Styrolux is a styrene butadiene block copolymere, having
00115 for example an amount of 20 to 28% butadiene. Styrolux
00116 is a product and a trade name of BASF.
00117
00118 The term "modified tough polystyrene" refers also to
00119 polystyrene with an additive as described in the Euro-
00120 pean patent 0 983 308 B1. The disclosure of this Euro-
00121 pean patent is imported by reference in the present
00122 application. This also in respect of features described
00123 in the said European patent to be incorporated in claims
00124 of the present application.
00125
00126 The advantage of the described concept is first the
00127 flexibility of producing a transparent or opaque vers-
00128 ion. Second is the very good properties of the outer
00129 layers, consisting of general purpose styrenic resins or
00130 polystyrene, especially in terms of printability. These
00131 are especially achieved by voiding particles such as
00132 gels, often present on the surface of 100% highly modi-
00133 fied styrenes, such as styrolux film. Further, with
00134 respect to shrink applications. Whereas shrink applicati-
00135 ons are very often in the wrapping, especially labeling
00136 technique, it is of advantage that the label-structure
00137 described here may be also without modifications be
00138 applied in non-shrink applications. Still further is
00139 also of advantage, that such label stock can be produced
00140 with a high amount of regular, general purpose polystyr-

ene, being available currently at comparatively low costs, whereas the additives such as butadiene, acrylat and so on are reduced compared to known structures, especially label-structures, based on polystyrene. It is also of advantage that a structure, especially a label-structure, according to a concept described here, both transparent and opaque, may be produced in a coextrusion process or a so called bubble blowing process, preferably single bubble process, or double bubble process. It is not necessary to use the very capital intensive tenter frame process. The bubble blowing or coextrusion process may also be a horizontal process, whereas the vertical process is preferred. In further detail for providing the opaque version, it is preferred, that the third layer is pigmented or voided or foamed. With respect to the foaming, it is also preferred, to foam on a chemically base, whereas it is also possible, to foam with inert additives. Beside this also the flat die coextrusion technique is useable with advantage. The voiding or foaming step provides two desirable features to the structure, especially label-structure, lower density due to the void pockets and light scattering of transmitted light improving opacity. Obviously, voiding is also of advantage in terms of weight. For the general concept, the first and second layer shall provide from 10 to 75 % of the overall weight/thickness of the label-structure. This is in more detail a share of 40 to 75% (especially up to 45% or between the latter value and up to 50%; or between the latter value and up to 55%, or between the latter value and up to 60%; or between the latter value and up to 65%; or between the latter value and up to 70%; or between the latter value and up to 75%) in case the third layer is transparent and therefore the hole structure, especially label-structure, is transparent, as the first and second layer are in all

versions transparent. And it is in the range of 10 to 50% (especially up to 15% or between the latter value and up to 20%; or between the latter value and up to 25%; or between the latter value and up to 30%; or between the latter value and up to 35%; or between the latter value and up to 40%; or between the latter value and up to 45%; or between the latter value and up to 50%) in case the third layer is opaque. The skin layers or outer layers respectively are balanced and form the bulk of the material being used.

Whereas it is presently preferred, to have always and at least three layer structure, especially label-structure, the inventive concept does also refer to a only two layer system. In such a two layer system, one layer is produced according to the mentioned first or second layer and the second layer is produced according to the mentioned third layer.

In further detail, it is also possible, to have such structure, especially label-structure, recycled and to have the recycled material combined to the third layer or even incorporated in a fourth, preferably inner layer. As to this it is not essential, but preferred, that the recycled material does consist of the same label stock. Since the materials used to produce the structure, especially label-structure, described here are compatible, the generated out of specification stock, especially label stock, and trim can be recycled into the outer layer of the opaque label stock by readjusting the additives as mentioned, especially the amount of virgin "K" resin used in the third layer. The recycled material can also be placed in a separate internal layer.

00211 Subject of the invention is also a method for producing
00212 a polystyrene based multi-layer structure, especially
00213 label-structure, with a middle layer (third layer) of
00214 tough polystyrene, having additives such as butadiene
00215 and acrylat or consisting of so called "K-resin" whereby
00216 is focused on that in a first step one or two outer
00217 layers are put on the middle layer preferably by coextru-
00218 sion, such outer layers consisting essentially of gene-
00219 ral purpose styrenic resins and that the so built label-
00220 structure will be in a second step blown up, whereby the
00221 middle layer functions as carrier in terms of toughness
00222 for the outer layers. The blowing up may be carried out
00223 in a so called bubble blowing process. As to further
00224 details of the method it is referred to the above des-
00225 cription.
00226
00227 Further subject matter of the invention is also an
00228 article such as a glass container, labeled with a multi-
00229 layer label-structure in one of the embodiments as des-
00230 cribed before. The container may also be a metal contai-
00231 ner or a plastic container.
00232
00233 Of importance is for all products and methods described
00234 that the srinkablity is in machine direction (MD).
00235 Especially only in machine direction. This means in
00236 extrusion direction. "Only" in machine direction does of
00237 course mean that there must be always also some little
00238 shrinkability in cross direction (CD) relative to the
00239 machine direction. However, this CD shrinkability is as
00240 low as possible, f.e. in the range 1 to 10% (2%, 3%, 4%,
00241 5%, 6%, 7%, 8%, 9% or even in between such values) of
00242 the shrinkablity in MD. Therefore, in the following it
00243 is refered in so far to a shrinkability "almost" only in
00244 machine direction.
00245

00246 In the following, the invention is described as example
00247 in terms of a film label-structure product, with
00248 reference to the accompaning drawings, wherein shows:
00249
00250 Fig. 1 a vertical sectional view of a first multi-
00251 layer film label-structure;
00252
00253 Fig. 2 a view according to fig. 1 of a second label-
00254 structure;
00255
00256 Described and shown is, first with reference to fig. 1,
00257 a cross sectional view of a first multi-layer film label-
00258 structure 1 with a middle layer 2 and two outer layers
00259 3, 4. The label-structure is transparent.
00260
00261 The middle layer 2 does consist of polystyrene, having
00262 additives such as butadiene and/or acrylat. More specifi-
00263 cally, the middle layer 2 may consist of a so called
00264 "K-resin", as it is produced by Philipps Petroleum Chemi-
00265 cals. The middle layer 2 may also consist of a mixture
00266 of approximatly 50 % polystyrene and 50 % styrolux.
00267 "Styrolux" refers to a styrene butadiene block copolymere
00268 having an amount of butadiene from 20 to 28%. The outer
00269 layers 3, 4 are nearly completly or up to about 75 % of
00270 pure, so called crystal polystyrene. The remainder of
00271 the outer layers may also be additives such as butadiene
00272 and/or acrylat.
00273
00274 The total thickness D1 of a label-structure according to
00275 fig. 1 be about 0,5 to at least 4 mils (0,012 to 0,102
00276 mm). The thickness can even be also essentially higher
00277 as 4 mils. The thickness d1 of the middle layer 2 is
00278 about halve of D1 (40%, 45%, 50%, 55% or 60% of d1 or
00279 even in between those values) or less, whereas the

00280 thickness d2 of the outer layer 3 or the outer layer 4
00281 is about one fourth (30%, 28%, 26%, 24%, 22%, 20% or
00282 even in between those values) of the overall thickness
00283 D1.
00284
00285 The transparency of a label-structure according to fig.
00286 1 is much higher than up to now known for a mono layer
00287 label. Further, the scratch resistance is improved. Also
00288 the printability is improved.
00289
00290 The label-structure 5 according to fig. 2 is opaque. The
00291 middle layer 6 of the label-structure 5 does consist of
00292 polystyrene, basically as described before. However, the
00293 middle layer 6 is foamed or voided or pigmented, such,
00294 that the transparency of polystyrene is suspended. The
00295 two outer layers 7 and 8 do again consist of pure,
00296 crystal polystyrene or slightly modified polystyrene,
00297 also as described above with reference to fig. 1. One or
00298 both outer layers are printed with f.e. trade names of
00299 the product, information to use the product and so on.
00300
00301 The overall thickness is about 7 µm. The thickness may
00302 vary within the ranges described above.
00303
00304 The features of the invention disclosed in the preceding
00305 description, the drawings and the claims may be individu-
00306 ally as well as in a free combination of importance for
00307 the realization of the invention. In the disclosure of
00308 the invention herewith also the disclosure of the appro-
00309 priate/attached priority document (copy of the prior
00310 application) are enclosed with their full content.